

# ON Semiconductor

## Is Now

# onsemi™

To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

---

**onsemi** and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

## RHYTHM™ R3910 Parameters



ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

### APPLICATION NOTE

#### INTRODUCTION

This application note provides a description for the Rhythm R3910 product parameters that you can adjust using the Application Resource Kit (ARK) software.

Refer to the [Application Resource Kit User's Guide](#) for information about using the features of the Application Resource Kit (ARK) software applications with ON Semiconductor preconfigured DSP products.

#### Settings Parameters

##### MSPullUpDown (MS2PullUpDown)

Setting this to **Pull Up** means the pads need to be tied to ground to activate the memory select. Setting to Pull Down means the pins should be tied to Vb.

##### MSSMode

Sets the memory select pads to work with either momentary or static switches.

##### DOnly

Activates DOnly memory select mode on MS2. When activated, a memory select on MS2 jumps to memory D. See the product-specific datasheet for a complete description of Donly mode.

##### MemIndicatorEn

Enables or disables the EVOKE™ memory select indicators.

##### ExtVC

Enables or disables the external volume control. When disabled, the Internal VC slider on the VC tab in IDS is used.

##### ExtVCRange

Sets the volume control range for the analog external volume control.

##### VCConfiguration

Sets the volume control configuration for either analog, digital, MMS (memory Switch functionality), or DVC + MMS. See the product-specific datasheet for complete details.

##### AnalogVCMapping

Maps the external volume control look-up table to the type of taper on the potentiometer. If using a linear taper, this setting should be set to "log".

##### DVC\_MS\_Behaviour

When VCConfiguration is set as DVC + MMS, this determines how the volume control and memory select behavior works. For example, `Shrt:DVC, Lng:MS` means a quick press of the switch activates the volume control functionality, and a longer press activates the memory select functionality.

##### DVC\_MS\_LengthTH

Sets the length of time for a button press to be considered "long".

##### DigVCThresh

Sets the difference from mid-rail that is used to detect high or low transitions on the analog VC pad while in digital VC mode. Typically, this should be left as the default setting.

##### DigVCRange

Sets the volume control adjustment range for a digital volume control.

##### DigVCDefault

Sets the default setting of the digital volume control when the device is powered on.

##### DigVCStepSize

Sets the gain change (in dB) for each step in the digital volume control.

##### DVCUpDnIndicatorEn

Enables or disables the Evoke indicators for the volume control increases and decreases.

##### DVCMinMaxIndicatorEn

Enables or disables the Evoke indicators for when the volume control reaches the minimum or maximum setting.

## LowBatMode

Enables or disables the Evoke low battery indicator.

## LowBatThresh

Sets the battery level at which the low battery indicator is played.

## StartupIndicatorEn

Enables or disables the Evoke indicator heard when the device is powered on.

## PowerOnDelay

Sets the delay time from when the device is first powered on until when the audio is turned on.

## TcoilDebounce

With Donly mode enabled, it works with a magnetic or reed switch on MS2 to create an automatic telephone detector. This function sets the time to remain in memory D when the magnetic field is removed and the switch is opened.

## PartLocked

Used to lock a hybrid to only work with a particular product library. For more information, refer to the section about “Security Features” in the [ARK User's Guide](#).

## MS2Lock

When set to locked, this disables the MS2 pin when the device is configured with DOnly enabled. This is useful for products that incorporate a magnetic or reed switch that requires the MS2 pin to be disabled.

## Datalogging Parameters

The following parameters pertain to the datalogging feature. These parameters are described in detail in the [ARK User's Guide](#).

- DataloggingEnable – Enables or disables the datalogging feature.
- LogInterval – This parameter allows you to select the length of time between log entries.
- LogAmbientLevel – Set this parameter to enabled if you want to log the ambient sound level.
- AmbientThreshold – This parameter allows you to set the threshold required to stimulate a new log entry.

## Input/Output Parameters

The Input/Output parameters control the in-channel wide dynamic range compression (WDRC) settings. To ensure that the Input/Output characteristics are continuous, it is necessary to limit adjustment to four of the first five WDRC parameters listed below:

## Lower Threshold

Controls the level at which the hearing aid begins to go into compression.

## Low Level Gain

Controls how much gain is applied before the lower threshold kneepoint.

## Upper Threshold

Controls the level at which the compression region ends.

## High Level Gain

Controls how much gain is applied after the upper threshold kneepoint.

## Compression Ratio

Within the compression region (defined by the lower threshold and upper threshold), this is the ratio of change in input level to the corresponding change in output level. This control allows you to define this ratio.

## Squelch Threshold

Also known as Low Level Squelch Threshold. This parameter defines the kneepoint below which expansion is applied to reduce the gain for softer sounds.

## Squelch Ratio

Controls the rate at which the gain is reduced as the input signal continues to drop below the squelch threshold kneepoint.

## AGCo

The automatic gain control–output (AGCo) parameter performs a wideband output limiting control that prevents the output from going above the specified full scale level. The output is reduced to that level before saturation occurs.

## Dynamics Parameters

The Dynamics parameters control the attack and release time constants for each of the channel detectors, the AGCo detector and the Squelch detectors. Each of the channels has the following detectors available:

- **FA** – Fast Attack
- **FR** – Fast Release
- **SA** – Slow Attack
- **SR** – Slow Release
- **SQA** – Squelch Attack
- **SQR** – Squelch Release

The wideband AGCo detector has the following parameters associated with it:

- **Slow Attack**
- **Slow Release**
- **AGCo Adaptive Mode** – The release time varies depending on the environment. More details are available in the corresponding product datasheets.

## **Frequency Shaping Parameters**

The Frequency Shaping parameters provide control over the bands in the Graphic EQ and the crossover frequencies for each compression channel. The frequencies, number of bands and number of crossover settings varies across products.

### **Graphic EQ Band Gains**

Each of the Graphic EQ bands is labeled with the frequency at which the gain of the band can be adjusted. The amount of attenuation that can be applied in each band varies across products.

### **CF1 – CFX**

X is the number of channels in the product less 1. The crossover frequencies define the bandwidth of each of the channels. For example, CF1 sets the upper cutoff frequency for channel 1 and the lower cutoff frequency for channel 2; CF2 sets the upper cutoff frequency for channel 2 and the lower cutoff frequency for channel 3.

## **Filters Parameters**

The Filters parameters are used for modifying the lowcut and highcut filters for the product.

### **LCCentre**

Controls the centre frequency of the lowcut filter.

### **LCOrder**

Controls the order of the lowcut filter.

### **HCCentre**

Controls the centre frequency of the highcut filter.

### **HCOOrder**

Controls the order of the highcut filter.

## **Pre–Biquads and Post–Biquads Parameters**

The pre–biquads and post–biquads parameters provide the ability to configure the generic biquad filters for the pre–emphasis filters and post–emphasis filters, respectively.

### **b0,b1,b2,a1,a2**

These parameters correspond to the quantized coefficients for the associated biquad. Refer to the [ARK User's Guide](#) for details of configuring the generic biquad filters.

### **meta0, meta1**

These parameters do not have any effect on the signal processing, but can be used to store additional information related to the associated biquad.

## **Volume Control Parameters**

### **WidebandGain**

The wideband gain parameter adjusts the gain across the entire frequency response.

### **VC**

When the ExtVC (see “Settings Parameters” on page 1) is disabled, this volume control (VC) setting will be applied to the audio path.

### **PC**

The PC (peak clipper) parameter sets a hard limit for the overall output of the system. No time constants are associated with this threshold. If the signal exceeds the threshold, it is clipped.

## **Front End Parameters**

### **FEMode**

The front end mode parameter allows you to select the active input mode.

### **Beta**

The beta parameter is used to adjust the internal time delay when the FEMode is set to directional.

### **LowFreqEQ**

This parameter adjusts the low frequency equalization when in directional mode. The low frequency equalization can be used to compensate for the 6 db/octave roll–off in frequency response that occurs in directional, adaptive directional, or auto ADM front end modes.

### **TCoilGain**

The gain to be applied to the telecoil input. This parameter is only available if you have customized your library using ARKonline® to override the telecoil calibration values with this parameter value.

### **TcoilNormFreq**

This is the frequency at which the telecoil compensation gain is specified when designing the telecoil compensation filter. This parameter value is applied when the front end mode is set to **telecoil** or **mic plus telecoil**.

### **TcoilCompCF**

The corner frequency used to configure the telecoil compensation low pass filter, when the front end mode is set to **telecoil** or **mic plus telecoil**.

### **MicAtten**

This setting indicates how much attenuation to apply to the microphone path when the front end mode is set to **mic plus telecoil** or **mic plus dai** mode.

### **DAICompGain**

The gain to be applied to the DAI input.

### **DAICompCF**

The corner frequency used to configure the DAI compensation low pass filter when the front end mode is set to **dai** or **mic plus dai**.

# AND9084/D

## Utilities Parameters

### HRX™

Enable or disable the Head Room Extension (HRX). When enabled, the input dynamic range is increased by adjusting the pre-amplifier's gain and the post-A/D attenuation.

## Advanced Features Parameters

Please see AND9020/D Adaptive Feedback Cancellation 3 from ON Semiconductor for more information.

### FeedBackCanceller

This parameter enables and disables the Feedback Canceller feature.

### FBCAcouDelay

The purpose of this parameter is to allow tuning of the Adaptive Feedback Canceller algorithm to different hearing aid designs. We recommend that for a particular hearing aid design, start with the default values and fine tune the Adaptive Feedback Canceller algorithm, if necessary, by making only small changes from these recommended default settings.

### Noise Reduction

Adjusts the level of noise reduction to be applied. A value of 0 dB disables the noise reduction feature.

## Tinnitus Parameters

Tinnitus treatment is implemented using an internal white noise generator. This white noise can be shaped and adjusted using the parameters below.

### Noise LC Order

A lowcut filter is provided with an adjustable slope for shaping the noise.

### Noise LC Corner

Adjusts the corner frequency of the lowcut filter.

### Noise HC Order

A highcut filter is provided with an adjustable slope for noise shaping.

### Noise HC Corner

Adjusts the corner frequency of the highcut filter.

### Noise Level

Attenuate the generated white noise to the desired level.

### Noise Type

The type of noise that is injected into the system can be set to flat or band-limited using this parameter. If set to flat, the noise biquads are disabled and bypassed. If set to enabled, the noise is passed through the biquads.

### Noise Insertion


The point in the audio path where the noise is injected is defined using this parameter.

It can be before the volume control so that changes to the volume control level also change the noise level or after the volume control to keep the noise level unaffected by the current volume level. This parameter also defines whether the device will be a tinnitus masker only, or be a hearing aid plus tinnitus masker.

## Environmental Classification Parameters

Please see AND9025/D iSceneDetect for more information.

HRX, RHYTHM and EVOKE are trademarks of Semiconductor Components Industries, LLC. ARKOnline is a registered trademark of Semiconductor Components Industries, LLC.

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative